

Project number: 6183
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Gender, Age and Diet Effects on Lamb Meat Quality



Key external stakeholders:

Sheep Meat Industry, Meat Industry Ireland, Sheep farmers, Scientists

Practical implications for stakeholders:

This study provides evidence that it is possible to finish purebred Scottish Blackface and crossbred store lambs on an all-concentrate or mixed forage(silage)-concentrate diets to meet specifications for the high priced European markets. Rams lambs have faster growths, superior feed conversion efficiency, and lower killout % and produce leaner carcasses. Crossbred lambs, represented in this study as Texel cross x Scottish Blackface lambs, were significantly superior to purebred Scottish Blackface lambs for production and carcass traits. Leaving lambs had minimal negative effects on meat tenderness or on pH irrespective of the age at slaughter. Leaving lambs entire offers producers significant production benefits with minimal negative effects on meat tenderness.

Main results:

- Castration of lambs decreased growth rates, decreased feed conversion efficiency and yielded carcasses of higher fat cover.
- Texel cross Scottish Blackface (TXSB) lambs had higher growth rates, feed conversion efficiencies, carcass weights with better carcass conformation than SB lambs. Increased cross breeding could potentially improve the viability and sustainability of hill sheep systems.
- No interactions were observed between sex and breed, suggesting that effects were consistent across both sexes
- Scottish Blackface (SB) male lambs can successfully meet higher carcass weight (> 18 kg+) specifications for more diverse markets outlets than the more restrictive markets for light lamb (< 13 kg) carcasses
- A tendency was recorded for decreased Warner Bratzler Shear Force (WBSF) values, indicative of greater tenderness, in meat from wether and SB lambs compared to ram and TXSB lamb, respectively.
- The ultimate pH (pHu) was greater in ram lambs, but it must be noted that both ram and wether lambs produced meat with acceptable pHu values.
- Total collagen content was greater in SB lambs than in TXSB lambs, while no differences were observed between ram and wether lambs.
- Intramuscular fat levels were higher in wether and SB lambs than TXSB lambs.
- Effects of age on the selected instrumental meat quality assessments were inconsistent.
- A tendency for decreased WBSF values, indicative of greater tenderness, in meat from wether and SB lambs compared to ram and TXSB lamb, respectively.
- The pHu was greater in ram lambs, but it must be noted that both ram and wether lambs produced meat with acceptable pHu values.
- Forage fed diets led to decreased WBSF values (greater tenderness) compared to concentrate fed lambs or lambs fed a mix of silage and concentrate
- No differences were found between concentrate feeding levels or duration of feeding for intramuscular fat levels.
- Meat colour could be deemed acceptable from each level of concentrate to forage ratio.

Opportunity / Benefit:

- Accelerated genetic gain through the exploitation of DNA information in the four selection pathways governing genetic gain

Collaborating Institutions:

University College Dublin,
AFBI, Hillsborough and New Forge Lane

Teagasc project team:

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1. Project background:

One of the challenges for the Irish sheep industry is to improve sheep production through greater on-farm efficiencies and to secure higher-priced stable export markets. One option would be to increase the proportion of ram lambs compared to wether lambs. Ram lambs offer improved growth efficiencies along with increased feed conversion efficiencies while producing leaner carcasses. This offers the Irish industry an opportunity for improved efficiency. However, there are a number of issues facing ram lamb production with the main challenge being the perception of deterioration in meat and eating quality attributes.

Currently, little information is available under Irish sheep management conditions on the variation in the sensory quality of lamb meat due to either lamb breed, gender or age at slaughter. The issue of meat quality and variation between gender (preference for castrated lambs) and age at slaughter has been frequently voiced by the meat industry and by Bord Bia clearly indicating the difficulty of finding sustainable customers for ram lamb meat and advocating castration of all male lambs destined for slaughter from August onwards. Although ram lambs are required for specific religious festivals many meat processors and industry representatives advise only castrated lambs be slaughtered from September until the new season lamb markets begins in March of the following year.

Markets for light lambs have decreased following collapse of the Mediterranean markets. These markets historically provided an outlet for lighter lambs, predominantly from hill flocks. Currently, and in light of the decline in the market for light carcasses, there is a urgent need to explore the potential to increase the output of lamb meat from the national hill flock by either increasing the carcass weight of purebred hill lambs or by crossing an increased proportion of hill ewes with lowland terminal sire breeds such as Texel. There is a paucity of information on these two options.

2. Questions addressed by the project:

- Assess the production performance of Scottish Blackface (SB) and Texel cross Scottish Blackface (TXSB) following an intensive 36 day indoor concentrate finishing period, and the effects of gender and age on instrumental meat quality of lambs to assess the predicted acceptability of lamb meat.
- Assess the effects of concentrate feeding level and feeding duration were examined on the production performance of TXSB ram lambs and the impact of concentrate to forage ratio on meat quality traits when measured instrumentally
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3. The experimental studies were:

A total of four studies were completed:

- **Study 1.** Effect of breed and castration on production and carcass traits of male lambs following an intensive finishing period
- **Study 2.** Effect of age, breed and castration on selected instrumental meat quality attributes of male lambs following an intensive finishing period
- **Study 3.** Effect of forage to concentrate ratio and duration of feeding on growth and feed conversion efficiency of male lambs

- **Study 4.** Effect of concentrate feeding level and duration on selected meat quality attributes of male lambs.

4. Main results:

- **Study 1.** The TXSB lambs were heavier at slaughter than SB lambs and ram lambs were heavier at slaughter than wether. Improved average daily gain (ADG), lower feed conversion ratio (FCR) and higher feed intake were recorded in TXSB lambs with consistency across the five slaughter time points. Rams had greater ADG and FCR compared to wether lambs and no differences were observed between sexes for feed intake. The TXSB lambs had higher killout percentages (KO) compared to SB while wether lambs had greater KO compared to rams. The TXSB lambs had heavier carcass weights with higher conformation grades and less fat cover than SB lambs while ram lambs had heavier carcasses than wether lambs. There was greater fat cover on the loin muscles of SB and wether lambs compared to TXSB and ram lambs, respectively. The results from this study suggest that TXSB lambs offer hill sheep farmers a potential strategy for improved lamb production efficiency, while ram lambs offer lamb finishers increased growth rates, higher FCR and produce a more desirable carcass than wether lambs.
- **Study 2.** The study involved five slaughter times between October and April. Intramuscular fat (IMF) content and total collagen concentration was higher for SB lambs than for TXSB lambs and there was a tendency for lower Warner Bratzler Shear Force (WBSF) values for SB lambs in *M. Longissimus thoracis et lumborum* (LTL) muscles. While no differences were observed between ram and wether lambs for total collagen content or cook loss, there was a tendency for greater tenderness in wether lambs. Effects of age were inconsistent and followed no clear trend for any traits, suggesting that the influence of age/slaughter time point, at least in this study, were minimal. Fresh and aged (11 days) meat colour values for a* (redness) were greater in TXSB than in SB lambs. This study demonstrated that there was little advantage of castration compared to non-castration for instrumental attributes and physical appearance of lamb meat.
- **Study 3.** Lambs fed concentrate diets had greater ADG, FCR) and carcass weight and carcasses with greater conformation score than lambs fed mixed concentrate-forage or all forage (silage) diets. Duration of feeding had no effect on production variables across all three concentrate inclusion levels. It was concluded that the inclusion of concentrates is needed to adequately finish lambs fed indoors. Feeding lamb's mixed concentrate-forage diets resulted in modest responses and may be a viable option for finishing lambs or to maintain growth in lambs when the cost of concentrate feed is high relative to the financial return on the lamb meat.
- **Study 4.** Lambs fed the forage fed diets had decreased Warner Bratzler Shear Force (WBSF) values compared to concentrate fed lambs while no differences were observed for ultimate Ph (pHu) and intramuscular fat (IMF) between concentrate to feeding ratios. Meat from concentrate fed lambs had increased redness (a*) compared to meat from lambs fed forage diets. This study highlighted the increased tenderness of meat from lambs fed forage diets compared to mixed concentrate-forage or all concentrate diets

5. Opportunity/Benefit:

- The results from this study suggest that TXSB lamb's offer hill sheep farmers a potential strategy for improved lamb production efficiency, while ram lambs offer lamb finishers increased growth rates, higher FCR and produce a more desirable carcass than wether lambs.
- This study demonstrated that there was little advantage of castration compared to non-castration for instrumental attributes and physical appearance of lamb meat.
- Feeding lamb's mixed concentrate-forage diets resulted in modest responses and may be a viable option for finishing lambs or to maintain growth in lambs when the cost of concentrate feed is high relative to the financial return on the lamb meat.
- This study highlighted the increased tenderness of meat from lambs fed forage diets compared to meat from lambs fed mixed concentrate-forage or all concentrate diets

6. Dissemination:

Peer Reviewed

1. Claffey NA, Fahey AG, Gkarane V, Moloney AP and Monahan FJ and Diskin MG. (2018). Effect of breed and castration on production and carcass traits of male lambs following an intensive finishing period. *Transl. Anim. Sci.* doi: 10.1093/tas/txy070
2. Claffey NA, Fahey AG, Gkarane V, Moloney AP, Monahan FJ, and Diskin MG. (2018). Effect of forage to concentrate ratio and duration of feeding on growth and feed conversion efficiency of male lambs. *Transl. Anim. Sci.* doi: 10.1093/tas/txy071

3. Gkarane, V., Allen, P., Gravador, R. S., Diskin, M. G., Claffey, N. A., Fahey, A. G., Brunton, N. P., Farmer, L. J., Moloney, A. P., & Monahan, F. J. (2017). Effect of castration and age at slaughter on sensory perception of lamb meat. *Small Ruminant Research*, 157, 65-74. doi:<https://doi.org/10.1016/j.smallrumres.2017.10.011>

Publications (in preparation)

1. Gkarane, V., Allen, P., Brunton, N. P., Gravador, R. S., Claffey, N. A., Harrison, S. M., Diskin, M. G., Fahey, A. G., Farmer, L. J., Moloney, A. P., & Monahan, F. J. (2018). Distinction of meat from lambs fed different concentrate-based diets: Application of Canonical Discriminant Analysis using sensory and volatile analysis data (in preparation).
2. Claffey, N.A., Diskin, M.G., Gkarane, V., Monahan, F.J., Moloney, A.P., & Fahey, A.G. 2018. Effect of age, breed and castration on selected instrumental meat quality attributes of male lamb following an intensive finishing period. In preparation for submission to *Animal*.
3. Claffey, N.A., Diskin, M.G., Gkarane, V., Monahan, F.J., Moloney, A.P., & Fahey, A.G. 2018. Effect of concentrate feeding level and duration on selected meat quality attributes of male lamb. In preparation for submission to *Small Ruminant Research*.

PhD theses

1. Claffey, N.A. (2018). Gender, Age and Diet Effects on Lamb Meat Quality.
2. Gkarane, V. (2018). Gender, Age and Diet Effects on Lamb Meat Flavour.

Presentations to international scientific conferences

1. Gkarane, V., Brunton, N., Allen, P., Harrison, S.M., Gravador, R.S., Claffey, N.A., Fahey, A.G., Diskin, M.G., Moloney, A.P., Farmer, L.J., Murphy, P., Monahan, F.J. Discrimination of lamb meat from rams fed different concentrate-based rations, In Proceedings of the 64th International Congress of Meat Science and Technology (in press) (Melbourne, Australia, 12-17 August 2017).
2. Gravador, R.S., Casey, C., Gkarane, V., Brunton, N. P., Fahey, A.G., Moloney, A.P., Allen, P., Claffey, N.A., Diskin, M.G., Farmer, L.J., Allen, P. & Monahan, F.J. Consumer acceptability of meat from lambs fed different pre-slaughter diets. (2018). In Proceedings of the 64th International Congress of Meat Science and Technology. (Melbourne, Australia, 12-17 August 2018).
3. Gravador, R.S., Moloney, A.P., Fahey, A.G., Brunton, N. P., Gkarane, V., Allen, P., Claffey, N.A., Diskin, M.G. & Monahan, F.J. (2018). Effect of duration of concentrate feeding on the n-3 PUFA content of lamb. In Proceedings of the British Society of Animal Science. (Dublin, Ireland, 9-13 April 2018).
4. Claffey, N.A., Diskin, M.G., Gkarane, V., Monahan, F.J., Moloney, A.P., & Fahey, A.G. 2018. Effect of breed and sex on selected meat quality traits of Irish lambs. In Proceedings of the British Society of Animal Science. (Dublin, Ireland, 9-13 April 2018).

Technical Publications

1. Claffey, N.A., Diskin, M.G., Gkarane, V., Monahan, F.J., Moloney, A.P., & Fahey, A.G. 2018. Meat Quality attributes of Irish Male Lambs. Teagasc TResearch Autumn Publication, Vol.3 24-25.

Industry Publications

1. Diskin MG (2017) Up-date on effects of gender on meat quality attributes. IFA Hill Sheep farmer's conference, Maam Cross 23rd May 2017.
2. Diskin MG (2017) Up-date on effects of gender on meat quality attributes. Teagasc Stakeholder Committee, 21st November 2016
3. Diskin MG (2017) Effects of leaving lambs entire on meat quality attributes. Meeting with Meat industry Ireland, Dublin. 13th April 2017
4. Diskin, MG, Claffey, Gottstein, M, Hynes, F, Lynch, C, Creighton, P, Good, G, Kelly, I, Costello, D, Garry, B & Campion, F (2016) Finishing Store Lambs on Autumn Pastures and on All-Concentrate Diets. Teagasc Store Lamb Open Day, 15 November 2016. 12 pages. <https://www.teagasc.ie/media/website/publications/2016/Store-Lamb-Open-Day-Booklet-Final-14-11-2016.pdf>

Toolkit to the sheep meat industry

1. Diskin, MG, Claffey, N. Bohan, A (2015) Store lamb finishing calculator. http://tnet.teagasc.net/sheep/docs/Final_Store_lamb_finishing_calculator_20-07-2015.xlsx

7. Compiled by: Dr. Michael G Diskin